# MRA at 3.0T

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## General Trends at 3.0T vs 1.5T

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## Increased SAR

- Limits flip angles and minimum TR for high-performance sequences
  - SSFP cine
  - Spin echo train imaging
  - CEMRA

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## B1 Inhomogeneity

- Shading in some regions
- Inhomogeneous contrast in some regions
- May make calibration of RF transmitter voltages difficult – varying flip angles within body regions

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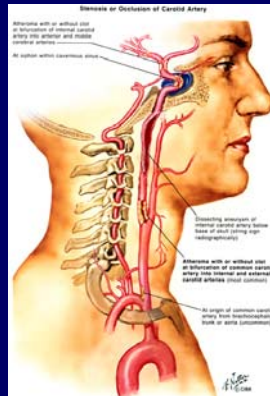## Carotid and Thoracic MRA at 3.0T

## Carotid Disease



Bifurcations

Origins

Intracranial

Vertebro-basilar

## CEMRA Procedure: typical

Center on head and do pre-Gd brain sequences

Center on neck via remote table movement (typical offset 140 mm)

Multiplanar scout images

timing-localizer (< 60 secs)

Run pre- and post-contrast, breath-held 3D MRA

Move table and do post-Gd brain sequences

## Contrast Injection Scheme

*Electronic infusion pump*

**Timing run with 2 ml Gd**

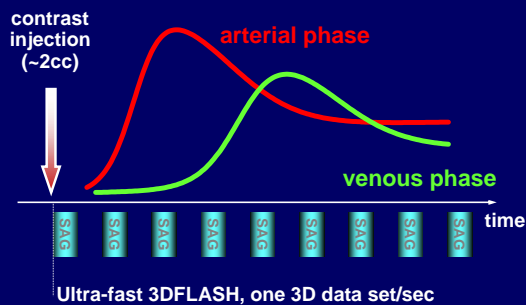**MRA: 20 ml Gd at ~ 1.2 ml /sec flow rate**

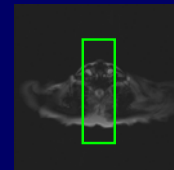**30 ml saline flush @ 1.2ml/sec**

## Also works at 1.5T!

*Carr JC, Ma J, Deshpande V, Pereles FS, Laub GL, Finn JP. High-Resolution Breath-Hold Contrast-Enhanced MR Angiography of the Entire Carotid Circulation. AJR 2002; 178:543-549*
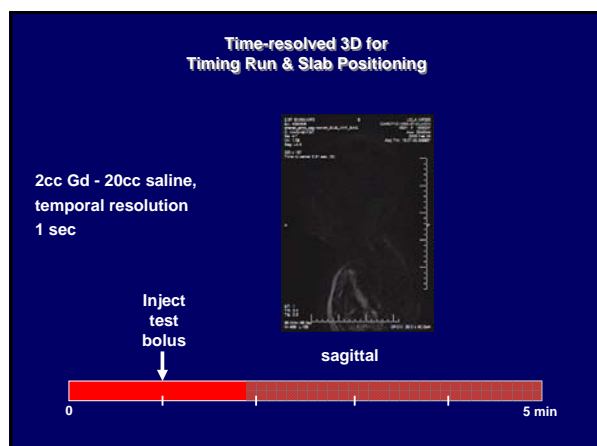
*Yang CW, MD; Carr JC, Futterer SF, Morasch MD, Benson P. Yang BP, Shors SM, Finn JP. Contrast-Enhanced Magnetic Resonance Angiography of the Vertebrobasilar Circulation. AJNR 2005 Sep;26(8):2095-101*

## TEST BOLUS



## Timing-run /Localizer

## Time-resolved 3D for Timing Run & Slab Positioning



2cc Gd - 20cc saline, temporal resolution 1 sec

Inject test bolus

sagittal

0              5 min

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## Time-resolved 3D

- **Nael K, Michaely H, Villablanca VP, et al. Time-resolved 3D MRA of the Head and Neck at 3.0T: Initial Results. Investigative Radiology 2006;41:116-124.**

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## CEMRA Protocol: Time-resolved 3D

Fast 3D GRE sequence:

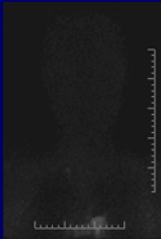TR/TE 2.1/0.9 ms, FA 15º, BW 1200 Hz/pixel

Matrix 384 x 256

Partition thickness 4 mm

GRAPPA x 3

5 ml Gd at 3 ml/s followed by 30 ml of saline flush

Temporal resolution ~ 1.5 secs

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## Time-Resolved 3D MRA



**5ml Gd, 1.5 secs per 3D phase**

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## CEMRA Protocol: High Resolution 3D

Nael K, Villablanca P, Pope W, Laub G, Finn JP.
*3D Contrast Enhanced MRA of the Head & Neck at 3.0T: Using Highly Acceleration Parallel Acquisition.* Radiology, in press.

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## CEMRA Protocol: High Resolution 3D

Fast 3D GRE sequence:

TR/TE 3/1.2 ms, FA 20º, BW 790 Hz/pixel
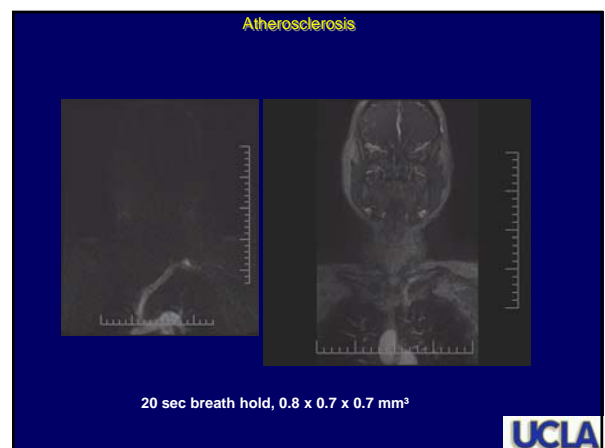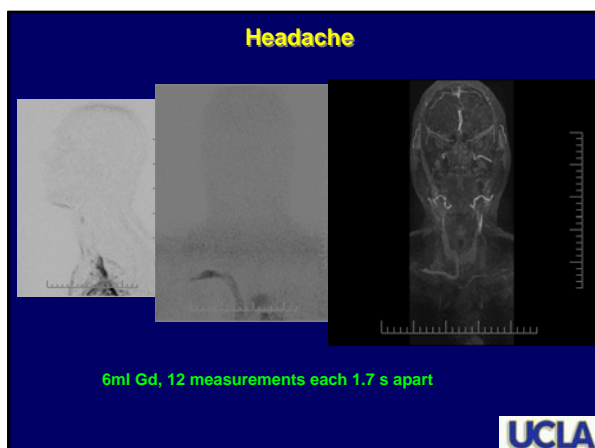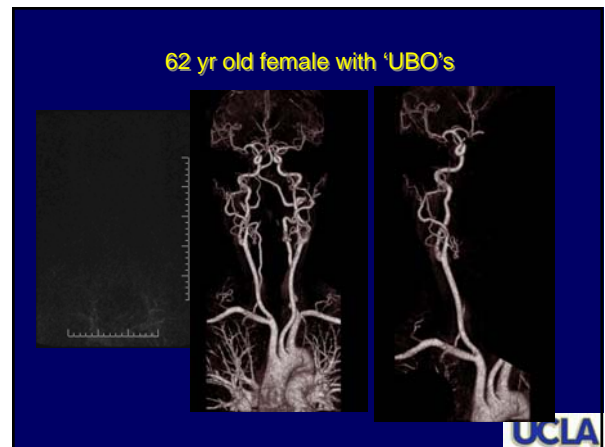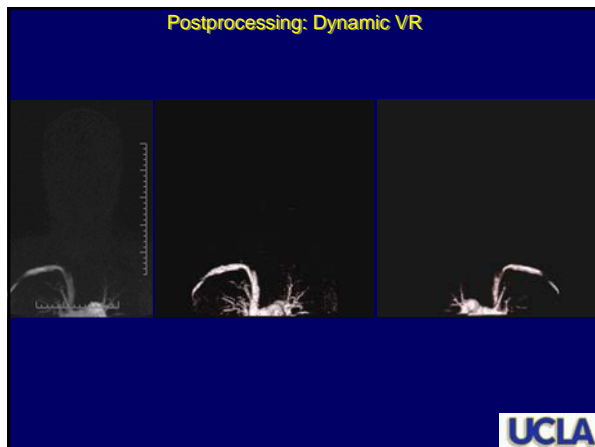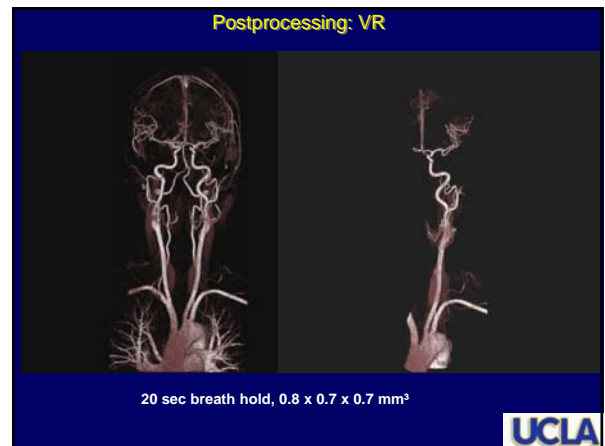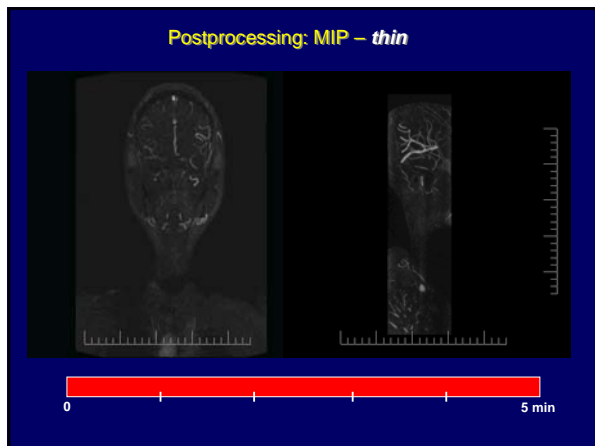
Matrix 460 x 576  (0.84 x 0.67 mm²)

Partition thickness 0.75 mm

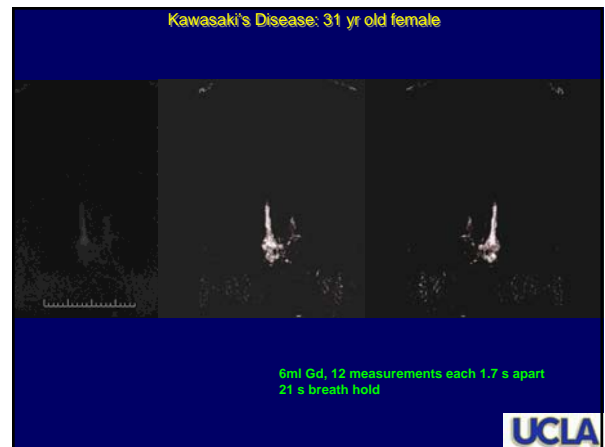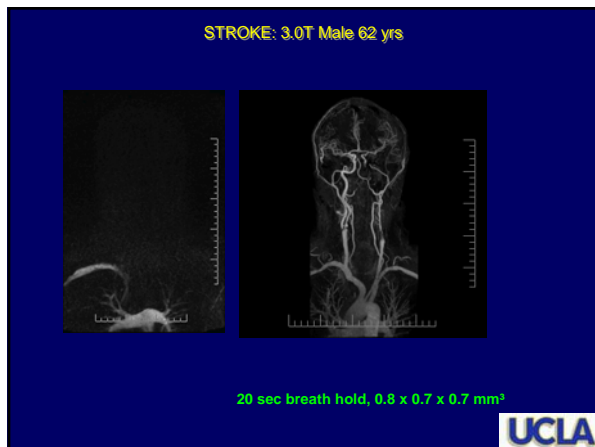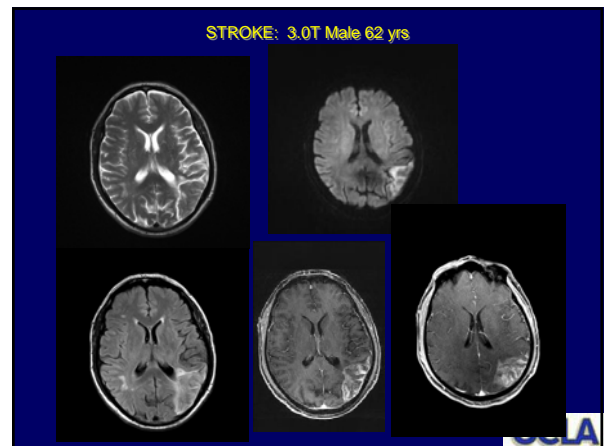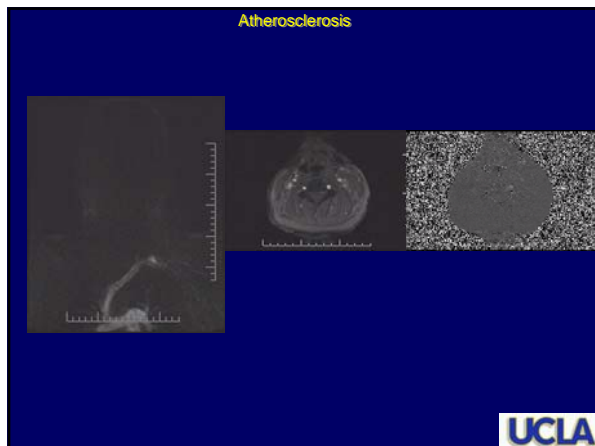GRAPPA x4

22 ml Gd at 1.2 ml/s followed by 30 ml of saline flush

A coronal 3D slab included the aortic arch, carotids and vertebro-basilar circulation in a 20 second breath-hold

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Postprocessing: MIP – *thin*

0    5 min



Postprocessing: VR

20 sec breath hold, 0.8 x 0.7 x 0.7 mm³



Postprocessing: Dynamic VR



62 yr old female with 'UBO's



Headache

6ml Gd, 12 measurements each 1.7 s apart



Atherosclerosis

20 sec breath hold, 0.8 x 0.7 x 0.7 mm³

Atherosclerosis


STROKE: 3.0T Male 62 yrs


STROKE: 3.0T Male 62 yrs

20 sec breath hold, 0.8 x 0.7 x 0.7 mm³


Kawasaki's Disease: 31 yr old female

6ml Gd, 12 measurements each 1.7 s apart
21 s breath hold



# Dynamic Pulmonary Perfusion and Flow Quantification 3.0 T vs 1.5 T

Nael K[1], Michaely HJ[1], Lee M[1], Goldin J[1], Laub G[2], Finn JP[1]

[1] Department of Radiological Sciences, David Geffen School of Medicine at UCLA
and [2] Siemens Medical Solutions


Dynamic SNR Evaluation

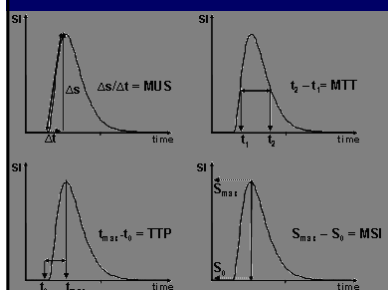ROIs were placed over the pulmonary arteries and over both lung fields separately

**Perfusion Semi-quantitative Analysis**

Gamma variate fit on a pixel by pixel basis calculates: MUS, MTT, TTP, MSI

$\Delta s / \Delta t = MUS$

$t_2 - t_1 = MTT$

$t_{max} - t_0 = TTP$

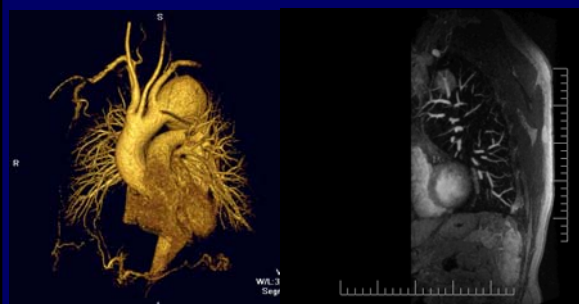$S_{max} - S_0 = MSI$



**Conclusion**

Anatomical vascular structures were seen with higher SNR at 3.0 T (consistent with theoretical predictions)

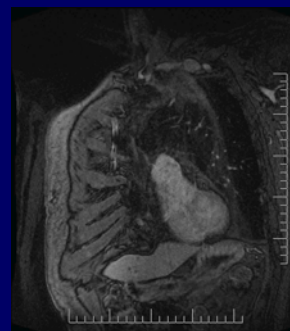Parenchymal enhancement (often related to microvascular perfusion) is better seen at 1.5 T than 3.0 T

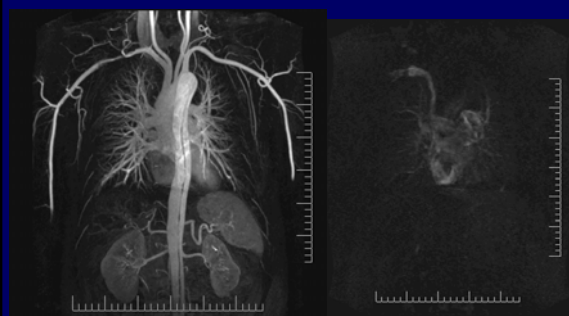No significant difference was found between F.Q. or quantitative perfusion analysis at 1.5 & 3.0 T



**3.0T Dissection**
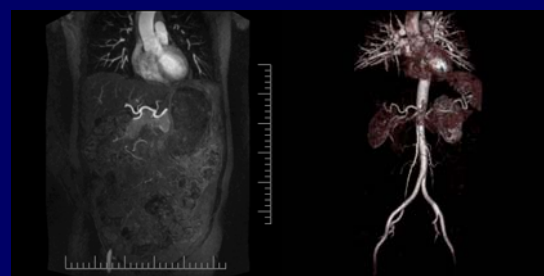


**3.0T Dissection: second phase**
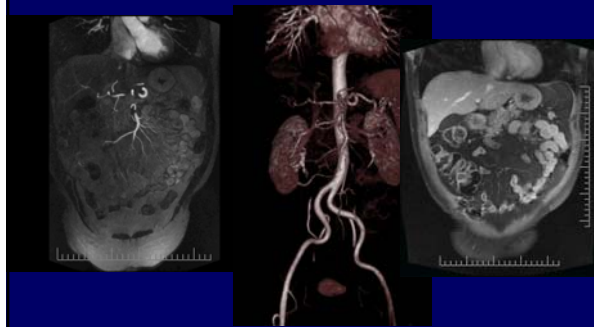


**TIM Trio: - dissection**

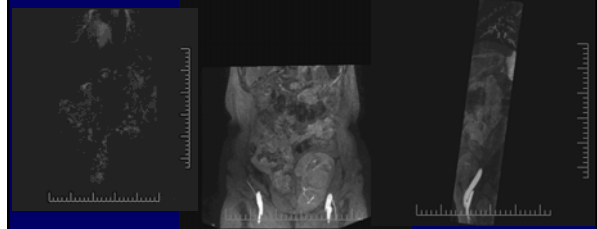6ml Gd, 12 measurements each 1.7 s apart
21 s breath hold: iPAT x 3; TREAT



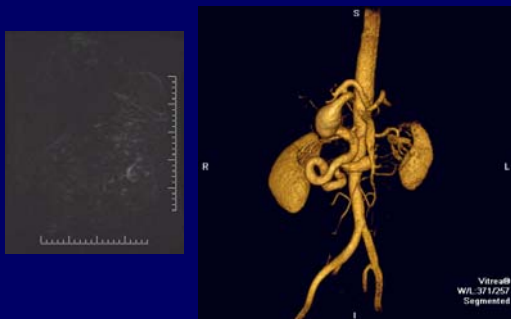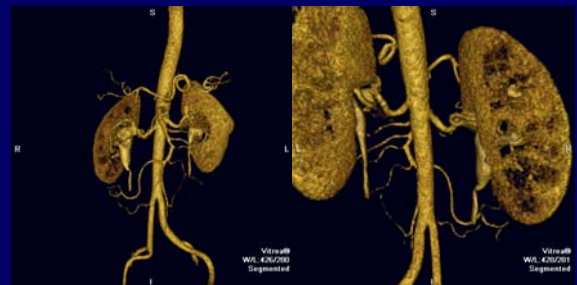**High Resolution MRA at 3.0 Tesla**

**High Resolution MRA at 3.0 Tesla**


Renal Transplant: 3.0T Tim Trio


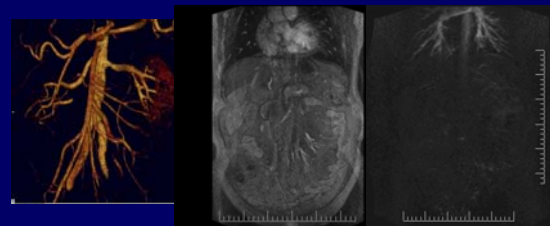**GI symptoms: M 55yrs**


Bilateral Renal Aneurysms

**Breath-hold, ~20 sec**
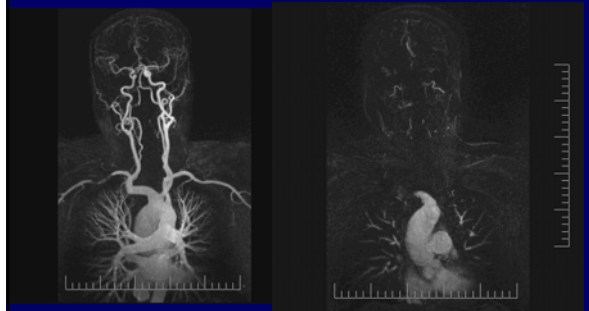**Parallel imaging iPAT x 3**
**injection of 25 ml Gd-DTPA**
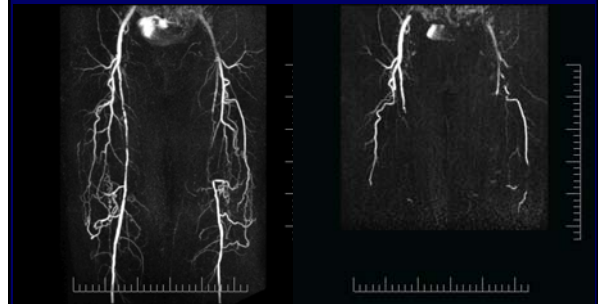

**TIM Trio: Branch Renal Artery Stenosis**


**TIM Trio: Renal Arteries**
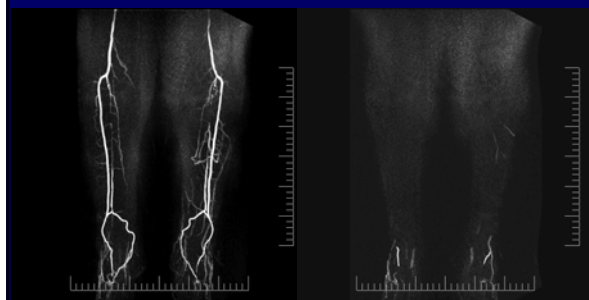
**TIM Trio:– whole body**



**TIM Trio:– whole body**



**TIM Trio:– whole body**



## Conclusion

MRA at 3.0T is versatile and mature

Only modest doses of contrast are required

Attention to detail is important

Post-processing can greatly enhance visualization

**Thank you**